



# Management of anomalous coronary anatomy during aortic valve repair

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## Clinical vignette

An asymptomatic 43-year-old male with an audible Grade III/IV early diastolic murmur was found to have a bicuspid aortic valve (BAV) with severe aortic valve insufficiency (AI) on transthoracic echocardiography. His left ventricular (LV) ejection fraction was 65% and LV end diastolic dimension 62 mm. Preoperative coronary computed tomographic (CT) angiogram ruled out coronary artery disease but demonstrated an anomalous origin of the left circumflex artery from the right coronary sinus, coursing around the base of the non-coronary sinus of the aortic root, in addition to an ascending aortic (AA) aneurysm (53 mm). He was scheduled for aortic valve (AV) repair and replacement of the AA with particular attention to management of the anomalous coronary artery.

## Surgical technique

### Preparation

The surgery was performed with the patient in supine position, single lumen endotracheal intubation and standard hemodynamic monitoring. A transesophageal echocardiography (TEE) probe was inserted for pre- and post-procedural assessment of the AV and cardiac function.

### Exposition

Following standard median sternotomy and hitching of the pericardium onto the sternum, cardiopulmonary bypass

was established by aortic and right atrial cannulation after systemic heparinization. After insertion of a LV vent through the right superior pulmonary vein, the aorta was clamped and transected 5–7 mm distal to the sino-tubular junction (STJ). The heart was then arrested through antegrade delivery of blood (del Nido) cardioplegia into both coronary ostia. Two 4-0 prolene traction sutures were placed above the anterior and posterior commissures. The aneurysmal AA segment was resected.

### Operation

Isolated AV repair can be performed if sinuses of Valsalva are not aneurysmal. The most common type of BAV is Sievers type I L/R, which involves fusion of the left and right coronary cusps with presence of a raphe (1). It is important to stabilize the aortic annulus to improve AV repair stability in BAV (2,3), particularly if the annular diameter is  $\geq 25$  mm. Stabilization is performed by suturing a Dacron band to the aortic annulus externally, in a horizontal plane at the level of the cusp nadirs. In cases where the left circumflex artery has an anomalous origin from the right coronary sinus and runs near the non/right commissure and base of the non-coronary sinus, this poses a major technical challenge.

As shown in the video, it is imperative to dissect and separate the entire course of the anomalous coronary artery from the aortic root down to the level of the sub-annular plane (aortic cusp nadirs). Interrupted 2-0 polyester pledgeted and non-pledgeted sub-annular sutures are

placed circumferentially in the fibrous and muscular annular segments, avoiding the origins and proximal segments of the left, right and anomalous coronary arteries. For an annular size ranging between 23–25 mm, a ring (3–4 serrations wide) cut from a 28–32 mm Dacron graft is usually adequate. This is then transected at one point to convert it into a band, so that it can be passed under the left and right coronary arteries. The sub-annular stitches are passed through the Dacron band and tied on a 24–26 mm Hegar dilator that is inserted through the aortic annulus.

Thereafter, the two commissural traction sutures are pulled up to assess the free margin length of both cusps and identify the presence or absence of prolapse. The prolapsing cusp, which most commonly is the fused cusp, is repaired by plicating the free margin with 5-0 polypropylene interrupted sutures as shown in the video. Thereafter, if prolapse of the non-fused leaflet is noted, it is similarly repaired. Such plication is performed until the line of coaptation is approximately 4 mm and lies as high as possible in the aorta, resulting in an effective height of  $\geq 9$  mm as measured with the Schaeffer's caliper. However, these metrics must be balanced with adequacy of the available valve orifice area in case of a BAV. Excess plication leads to shortening of the free margin and restricted opening of the cusps causing reduction in the valve orifice area, turbulent transvalvular flow and premature valve failure. Following this, the STJ is remodeled and fixed with an appropriately sized Dacron band or graft, as this has been shown to provide superior freedom from AV reinterventions (4). Cusp effective height should be reassessed once the STJ is fixed.

### Completion

Following AA replacement and LV de-airing, the aorta is unclamped. After weaning from cardiopulmonary bypass, TEE assesses presence/absence of AI, coaptation length and effective height of the cusps, transvalvular gradients and regional wall motion abnormalities, particularly in presence of anomalous coronary arteries. Thereafter, protamine is administered. Hemostasis is achieved and the chest is closed in routine fashion.

### Comments

Anomalous coronary arteries pose a significant challenge in patients undergoing AV or root surgery. Therefore, it is imperative to delineate the origin and course of anomalous coronary arteries and their anatomical relation to the aortic

root prior to surgery with a coronary CT angiogram (5). High coronary artery take-off, intramural course, anomalous origin and close proximity of the ostia to the commissures can result in catastrophes, if not detected prior to surgery. Although most variants can be managed well during an AV replacement, an intramural course at the level of the aortic annulus can be particularly difficult to negotiate. Use of sutureless or rapid deployment valves may be an attractive option. Intramural course within the aortic wall and anomalous origins are particularly challenging during aortic root replacement procedures. Mobilization or relocation of ostia or unroofing of the intramural course may be required.

The most challenging procedure in such situations is AV repair or sparing operations, in which aortic annuloplasty to fix the annulus is necessary. Close annular proximity of coronary arteries, such as the one presented in the accompanying video, make it imperative to dissect the anomalous coronary artery off its attachment to the aortic annulus and LV outflow tract to the point where sub-annular sutures can be safely placed without risk of either injury or iatrogenic kinking of the coronary artery. Following repair, the entire course of the coronary artery that is in danger of injury should be checked and presence of any corresponding regional wall motion abnormality on TEE should be ruled out.

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### Footnote

*Conflicts of Interest:* The authors have no conflicts of interest to declare.

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